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(54) Title of the Invention

POLYPROPYLENE RESIN COMPOSITION FOR CALENDERING

(57) Abstract

Object

The object of the present invention is to provide a polypropylene resin composition suitable for calendering.

Structure

A polypropylene resin composition for calendering consisting of a propylene homopolymer having a crystallization temperature of 110-125°C and a melt viscosity of 0.8-3.5 (measured by a method conforming to JIS-K-6758) and containing 0.03-0.10 wt.% of calcium stearate and 0.1-0.5 wt.% of a phosphate-based stabilizer.

Patent Claim

Claim 1

A polypropylene resin composition for calendering consisting of a propylene homopolymer having a crystallization temperature of 110-125°C and a melt viscosity of 0.8-3.5 (measured by a method conforming to JIS-K-6758) and containing 0.03-0.10 wt.% of calcium stearate and 0.1-0.5 wt.% of a phosphate-based stabilizer.

[0001]

Field of Industrial Utilization

The present invention relates to a polypropylene resin composition, in particular to a polypropylene resin composition suitable for calendering.

[0002]

Prior Art Technology

Since polyolefin resins, in particular crystalline polyolefins, have excellent physical and chemical properties, they have found wide application as a type of resin for general applications.

Among these applications, stretched films having excellent transparency and mechanical strength are widely used as packaging materials. Moreover, sheets having very good heat resistance are widely used for packaging food. However, when polypropylene sheets or films are manufactured, the processing must be conducted at a high temperature because of the crystalline structure of the resin and its high crystallization temperature. For this reason, extruders suitable for processing at a high temperature, such as a T-die, are usually used to process such resins. Various attempts have also been made to manufacture films or sheets by calendering.

[0003] For example, Unexamined Japanese Patent Application Showa 53-119946 disclosed calendering of a composition containing a random copolymer of propylene and ethylene and a block copolymer of propylene and ethylene. Furthermore, since propylene homopolymer, as described above, is crystalline and has a high crystallization temperature, plasticization cannot proceed sufficiently at a temperature at which calendering is usually conducted. However, if calendering is carried out at a high temperature, the propylene homopolymer changes its color. To overcome this problem, it was suggested to mix polypropylene with a thermoplastic elastomer and add a metal soap to the obtained polyolefin elastomer (Unexamined Japanese Patent Application Heisei 7-26077) or to add a phosphate (Unexamined Japanese Patent Application Heisei 6-157833).

[0004]

Problems Addressed by the Invention

The inventors have conducted an intensive study of methods for calendering propylene homopolymer. The results of this study laid the foundation for the present invention. The object of the present invention is to provide a propylene homopolymer composition suitable for calendering.

[0005]

Means to Overcome the Problem

The present invention relates to a polypropylene resin composition for calendering consisting of a propylene homopolymer having a crystallization temperature of 110-125°C and a

melt viscosity of 0.8-3.5 (measured by a method conforming to JIS-K-6758) and containing 0.03-0.10 wt.% of calcium stearate and 0.1-0.5 wt.% of a phosphate-based stabilizer.

[0006] Thus, in accordance with the present invention, in the polypropylene resin composition for calendering, a homopolymer having a crystallization temperature of 110-125°C and a melt viscosity of 0.8-3.5, as measured by a method conforming to JIS-K-6758, is selected as a propylene polymer, and 0.03-0.10 wt.% of calcium stearate and 0.1-0.5 wt.% of a phosphate-based stabilizer are added to this homopolymer, which makes it possible to manufacture the target sheets or films of propylene homopolymer by calendering without any slipping of the resin composition during calendering or roll indentation.

[0007] The present invention will be described below in greater detail. The present invention uses a propylene homopolymer. This homopolymer is superior to copolymers in terms of mechanical and physical properties, such as rigidity and heat resistance. A propylene homopolymer with a crystallization temperature of 110-125°C and a melt viscosity of 0.8-3.5, as measured by a method conforming to JIS-K-6758, is selected as the propylene homopolymer used in the invention composition. In accordance with the present invention, it is preferred that the obtained polypropylene sheet or film demonstrate no shrinkage in subsequent heat treatment. Therefore, the calendering temperature must be set within a range from 170 to 200°C. However, if the melt viscosity of the polypropylene homopolymer exceeds 3.5, calendering cannot be conducted in this temperature range. On the other hand, when the melt viscosity is less than 0.8, the processing becomes possible if the calendering temperature is raised, but, in such a case, the polypropylene homopolymer demonstrates undesirable thermal degradation. Furthermore, the crystallization temperature of the homopolymer is selected within a range from 110 to 125°C for the same reason as was taken into account in the selection of melt viscosity described above.

[0008] The amount of calcium stearate added to the homopolymer is 0.03-0.10 wt.%. When this amount is less than 0.03 wt.%, the homopolymer can easily stick to the calender rolls and calendering becomes impossible. On the other hand, when this amount exceeds 0.10 wt.%, the composition is difficult to knead. Furthermore, the phosphate-based stabilizer is added in an

amount of 0.1-0.5 wt.%. The phosphate-based stabilizer as referred to in this specification is a stabilizer that is usually added to provide polyolefin resins with heat and oxidation resistance. Tris(2,4-di-t-butylphenyl) phosphite [sic] is the preferred stabilizer of this type. When the phosphate-based stabilizer and calcium stearate are added individually, the sliding properties of the product are degraded and the amount of additive must be increased. However, when these additives are used in a large amount, they can be blown out of polypropylene, producing an adverse effect when, for example, the obtained film or sheet is used for printing or adhesive bonding. Furthermore, when other metal soaps, such as zinc stearate and barium stearate, are used instead of calcium stearate as a slip additive, the sliding properties of the product are not as good as those obtained when calcium stearate is used. Furthermore, other additives, such as a filler, a pigment, an antistatic agent, a phenol-based antioxidant, a photostabilizer based on a hindered amine, and a UV absorbent, may also be added by the usual method to the above-described composition consisting of polypropylene homopolymer.

[0009] The resin composition in accordance with the present invention is obtained by adding the prescribed amounts of calcium stearate and a phosphate-based stabilizer to a propylene homopolymer, adding other components, if necessary, and kneading in a roll mixer, a Banbury mixer, or an extruder. A polypropylene sheet or film is obtained by calendering the obtained composition. The thickness of the polypropylene sheet or film varies depending on the type of application. Usually the minimum and maximum attainable thickness is 0.03-0.05 mm and 0.7-1.0 mm, respectively. These film or sheet products are suitable for various applications, such as for building materials, vehicles, food containers etc. However, the especially preferred application is that for building materials. Laminates prepared by printing a pattern on the front surface of the polypropylene sheet and applying an adhesive layer to the back surface demonstrate excellent properties as trimming materials for household appliances or mounting laminates for construction materials since they maintain excellent properties inherent to propylene homopolymer and show no deformation even in secondary heating conducted to bond them to angular structures.

[0010] The present invention will be described below in greater detail with reference to its embodiments.

Embodiments 1-9, Comparative Examples 1-9

Propylene homopolymer compositions were manufactured by using propylene polymers A-C, adding phosphate and calcium stearate in the amounts shown in Tables 1 and 2, and kneading in a kneader. The compositions were calendered into films having a thickness of 0.1 mm in a calender heated to a temperature of 175-200°C. Kneadability and calenderability of the obtained compositions at a temperature of 175°C and 200°C were measured and evaluated. Propylene homopolymers presented in Tables 1 and 2 had the following properties.

P.P.-A: melt viscosity 0.8, crystallization temperature 117°C.
P.P.-B: melt viscosity 2.0, crystallization temperature 123°C.
P.P.-C: melt viscosity 3.5, crystallization temperature 113°C.
P.P.-D: melt viscosity 4.0, crystallization temperature 115°C.
P.P.-E: melt viscosity 1.3, crystallization temperature 128°C.

The evaluation criteria were as follows.

Kneadability:

O - can be easily kneaded.

Δ - some sliding, discharge is unstable.

Calenderability:

O - can be processed

X - adhesion, surface roughening, or plate-out.

Adhesive properties and printability:

O - good

X - peels off.

[0011]

Table 1

	Emb. 1	Emb. 2	Emb. 3	Emb. 4	Emb. 5	Emb. 6	Emb. 7	Emb. 8	Emb. 9
P.P. A	100			100			100		
P.P. B		100			100			100	
P.P. C			100			100			100
Phosphate	0.1	0.1	0.1	0.3	0.3	0.3	0.5	0.5	0.5
Ca stearate	0.03	0.03	0.03	0.07	0.07	0.07	0.10	0.10	0.10
Kneadability	O	O	O	O	O	O	Δ	Δ	Δ
Calender at 175°C	O	O	O	O	O	O	O	O	O
Calender at 200°C	O	O	O	O	O	O	O	O	O
Adhesive properties and printability	O	O	O	O	O	O	O	O	O

[0012]

Table 2

	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4	Comp. Ex. 5	Comp. Ex. 6	Comp. Ex. 7	Comp. Ex. 8	Comp. Ex. 9
P.P. A	100			100			100		
P.P. B		100			100			100	
P.P. C			100			100			100
Phosphate	1	1	1				0.7	0.7	0.7
Ca stearate				0.15	0.15	0.15	0.12	0.12	0.12
Kneadability	O	O	O	O	O	O	X	X	X
Calender at 175°C	X	X	X	X	X	X	O	O	O
Calender at 200°C	X	X	X	X	X	X	O	O	O
Adhesive properties and printability	X	X	X	O	O	O	Δ	Δ	Δ

[0013]

Embodiments 10-12, Comparative Examples 10 and 11

Propylene polymers D and E were used instead of propylene polymers A - C used in Embodiments 1-9 and Comparative Examples 1-6, phosphate and calcium stearate were added in amounts shown in Table 2, and resin compositions were manufactured, kneaded, and calendered in the same manner as in Embodiments 1-9 and Comparative Examples 1-9. In these examples,

calcium phosphate and calcium stearate were added during the granulation of the propylene polymers.

P.P.-D: melt viscosity 4.0, crystallization temperature 115°C.

P.P.-E: melt viscosity 1.3, crystallization temperature 128°C.

Calendering characteristics of the obtained compositions at a temperature of 175°C and 200°C were studied in the same manner as in Embodiments 1-9 and Comparative Examples 1-6. The easiness of sheet bonding to angular structures was also studied. Symbol O refers to good flexibility and symbol X refers to a rigid material that cannot be bent.

[0014]

Table 3

	Comp. Ex. 10	Comp. Ex. 11	Emb. 10	Emb. 11	Emb. 12
P.P. A			100		
P.P. B				100	
P.P. C					100
P.P. D	100				
P.P. E		100			
Phosphate	0.2	0.2	0.2	0.2	0.2
Ca stearate	0.05	0.05	0.05	0.05	0.05
Calender at 175°C	Drooping X	Rigid X	O	O	O
Calender at 200°C	Drooping X	O	O	O	O
Bonding to angular structures	-	Rigid X	O	O	O

[0015]

Effect of the Invention

As described above, the present invention provides a resin composition prepared by using a propylene homopolymer having a specific melt viscosity and specific crystallization temperature and adding calcium stearate and a phosphate-based stabilizer to the polymer in the prescribed amounts. This resin composition can be easily calendered, and polypropylene sheets and films having excellent properties inherent to propylene homopolymer can be obtained.